

FIG. 1A

*Alcaligenes (Deleya) aquamarinus* Catalase - 64CA2

(SEQ ID NO:5)

(SEQ ID NO:6)

1 ATG AAT AAC GCA TCC GCT GAC GAT CTA CAC AGT AGC TTG CAG CAA AGA TGC AGA GCA TTT 60  
 1 Met Asn Asn Ala Ser Ala Asp Asp Leu His Ser Ser Leu Gln Gln Arg Cys Arg Ala Phe 20  
 61 GTT CCC TTG GTA TCG CCA AGG CAT AGA GCA ATA AGG GAG AGA GCT ATG AGC GGT AAA TGT 120  
 21 Val Pro Leu Val Ser Pro Arg His Arg Ala Ile Arg Glu Arg Ala Met Ser Gly Lys Cys 40  
 121 CCT GTC ATG CAC GGT AAC ACC TCG ACC GGT ACT TCC AAC AAA GAT TGG TGG CCG GAA 180  
 41 Pro Val Met His Gly Gly Asn Thr Ser Thr Gly Thr Ser Asn Lys Asp Trp Trp Pro Glu 60  
 181 GGG TTG AAC CTG GAT ATT TTG CAT CAG CAA GAT CGC AAA TCA GAC CCG ATG GAT CCG GAT 240  
 61 Gly Leu Asn Leu Asp Ile Leu His Gln Gln Asp Arg Lys Ser Asp Pro Met Asp Pro Asp 80  
 241 TTC AAC TAC CGT GAA GAA GTA CGC AAG CTC GAT TTC GAC GCG CTG AAG AAA GAT GTC CAC 300  
 81 Phe Asn Tyr Arg Glu Val Arg Lys Leu Asp Phe Asp Ala Leu Lys Lys Asp Val His 100  
 301 GCG TTG ATG ACC GAT AGC CAA GAG TGG TGG CCC GCT GAC TGG GGG CAC TAC GGC GGT TTG 360  
 101 Ala Leu Met Thr Asp Ser Gln Glu Trp Trp Trp Pro Ala Asp Trp Gly His Tyr Gly Gly Leu 120  
 361 ATG ATC CGT ATG GCT TGG CAC TCC GCT GGC ACC TAC CGT ATT GCT GAT GGC CGT GGG GGC 420  
 121 Met Ile Arg Met Ala Trp His Ser Ala Gly Thr Tyr Arg Ile Ala Asp Gly Arg Gly Gly 140  
 421 GGT GGT ACC GGA AGC CAG CGC TTT GCA CCG CTC AAC TCC TGG CCG GAC AAC GTC AGC CTG 480  
 141 Gly Gly Thr Gly Ser Gln Arg Phe Ala Pro Leu Asn Ser Trp Pro Asp Asn Val Ser Leu 160  
 481 GAT AAA GCG CGC CGT CTG CTG TGG CCG ATC AAG AAG TAC GGC AAC AAA ATC AGC TGG 540  
 161 Asp Lys Ala Arg Arg Leu Leu Trp Pro Ile Lys Lys Lys Tyr Gly Asn Lys Ile Ser Trp 180  
 541 GCA GAC CTG ATG ATT CTG GCT GGC ACC GTG GCT TAT GAG TCC ATG GGC TTA CCT GCT TAC 600  
 181 Ala Asp Leu Met Ile Leu Ala Gly Thr Val Ala Tyr Glu Ser Met Gly Leu Pro Ala Tyr 200  
 601 GGC TTC TCT TTC GGC CGC GTC GAT ATT TGG GAA CCC GAA AAA GAT ATC TAC TGG GGT GAC 660  
 201 Gly Phe Ser Phe Gly Arg Val Asp Ile Trp Glu Pro Glu Lys Asp Ile Tyr Trp Gly Asp 220

FIG. 1B

661 GAA AAA GAG TGG CTG GCA CCT TCT GAC GAA CGC TAC GGC GAC GTG AAC AAG CCA GAG ACC 720  
221 Glu Lys Glu Trp Leu Ala Pro Ser Asp Glu Arg Tyr Gly Asp Val Asn Lys Pro Glu Thr 240

721 ATG GAA AAC CCG CTG GCG GCT GTC CAA ATG GGT CTG ATC TAT GTG AAC CCG GAA GGT GTT 780  
241 Met Glu Asn Pro Leu Ala Val Gln Met Gly Leu Ile Tyr Val Asn Pro Glu Gly Val 260

781 AAC GGC CAC CCT GAT CCG CTG AGA ACC GCA CAG CAG GTA CTT GAA ACC TTC GCC CGT ATG 840  
261 Asn Gly His Pro Asp Pro Leu Arg Thr Ala Gln Val Leu Glu Thr Phe Ala Arg Met 280

841 GCG ATG AAC GAC GAA AAA ACC GCA GCC CTC ACA GCT GGC GGC CAC ACC GTC GGT AAT TGT 900  
281 Ala Met Asn Asp Glu Lys Thr Ala Ala Leu Thr Ala Gly Gly His Thr Val Gly Asn Cys 300

901 CAC GGT AAT GGC AAT GCC TCT TTA GCC CCT GAC CCA AAA GCC TCT GAC GTT GAA AAC 960  
301 His Gly Asn Gly Asn Ala Ser Ala Leu Ala Pro Asp Pro Lys Ala Ser Asp Val Glu Asn 320

961 CAG GGC TTA GGT TGG GGC AAC CCC AAC ATG CAG GGC AAG GCA AGC AAC GCC GTG ACC TCG 1020  
321 Gln Gly Leu Gly Trp Gly Asn Pro Asn Met Gln Gly Lys Ala Ser Asn Ala Val Thr Ser 340

1021 GGT ATC GAA GGT GCT TGG ACC ACC AAC CCC ACG AAA TTC GAT ATG GGC TAT TTC GAC CTG 1080  
341 Gly Ile Glu Gly Ala Trp Thr Thr Asn Pro Thr Lys Phe Asp Met Gly Tyr Phe Asp Leu 360

1081 CTG TTC GGC TAC AAT TGG GAA CTG AAA AAG AGT CCT GCC GGT GCC CAC CAT TGG GAA CCG 1140  
361 Leu Phe Gly Tyr Asn Trp Glu Leu Lys Lys Ser Pro Ala Gly Ala His His Trp Glu Pro 380

1141 ATT GAC ATC AAA AAG GAA AAC AAG CCG GTT GAC GCC AGC GAC CCC TCT ATT CGC CAC AAC 1200  
381 Ile Asp Ile Lys Lys Glu Asn Lys Pro Val Asp Ala Ser Asp Pro Ser Ile Arg His Asn 400

1201 CCG ATC ATG ACC GAT GCG GAT ATG GCG ATA AAG GTA AAT CCG ACC TAT CGC GCT ATC TGC 1260  
401 Pro Ile Met Thr Asp Ala Asp Met Ala Ile Lys Val Asn Pro Thr Tyr Arg Ala Ile Cys 420

1261 GAA AAA TTC ATG GCC GAT CCT GAG TAC TTC AAG AAA ACT TTC GCG AAG GCG TGG TTC AAG 1320  
421 Glu Lys Phe Met Ala Asp Pro Glu Tyr Phe Lys Lys Thr Phe Ala Lys Ala Trp Phe Lys 440

1321 CTG ACG CAC CGT GAC CTG GGC CCG AAA TCA CGT TAC ATC GGC CCG GAA GTG CCG GCA GAA 1380  
441 Leu Thr His Arg Asp Leu Gly Pro Lys Ser Arg Tyr Ile Gly Pro Glu Val Pro Ala Glu 460

FIG. 1C

1381 GAC CTG ATT TGG CAA GAC CCG ATT CCG GCA GGT AAC ACC GAC TAC TGC GAA GAA GTG GTC 1440  
 461 Asp Leu Ile Trp Gln Asp Pro Ile Pro Ala Gly Asn Thr Asp Tyr Cys Glu Glu Val Val 480  
 1441 AAG CAG AAA ATT GCA CAA AGT GGC CTG AGC ATT AGT GAG ATG GTC TCC ACC GCT TGG GAC 1500  
 481 Lys Gln Lys Ile Ala Gln Ser Gly Leu Ser Ile Ser Glu Met Val Ser Thr Ala Trp Asp 500  
 1501 AGT GCC CGT ACT TAT CGC GGT TCC GAT ATG CGC GGC GGT GCT AAC GGT GCC CGC ATT CGC 1560  
 501 Ser Ala Arg Thr Tyr Arg Gly Ser Asp Met Arg Gly Ala Asn Gly Ala Arg Ile Arg 520  
 1561 TTG GCC CCA CAG AAC GAG TGG CAG GGC AAC GAG CCG GAG CGC CTG GCG AAA GTG CTG AGC 1620  
 521 Leu Ala Pro Gln Asn Glu Trp Gln Gly Asn Glu Pro Glu Arg Leu Ala Lys Val Leu Ser 540  
 1621 GTC TAC GAG CAG ATC TCT GCC GAC ACC GGC GCT AGC ATC GCG GAC GTG ATC GTT CTG GCC 1680  
 541 Val Tyr Glu Gln Ile Ser Ala Asp Thr Gly Ala Ser Ile Ala Asp Val Ile Val Leu Ala 560  
 1681 GGT AGC GTA GGC ATC GAG AAA GCC GCG AAA GCA GCA GGT TAC GAT GTG CGC GTT CCC TTC 1740  
 561 Gly Ser Val Gly Ile Glu Lys Ala Ala Lys Ala Ala Gly Tyr Asp Val Arg Val Pro Phe 580  
 1741 CTG AAA GGC CGT GGC GAT GCG ACC GCC GAG ATG ACC GAC GCA GAC TCC TTC GCA CCG CTG 1800  
 581 Leu Lys Gly Arg Gly Asp Ala Thr Ala Glu Met Thr Asp Ala Asp Ser Phe Ala Pro Leu 600  
 1801 GAG CCG CTG GCC GAT GGC TTC CGC AAC TGG CAG AAG AAA GAG TAT GTG GTG AAG CCG GAA 1860  
 601 Glu Pro Leu Ala Asp Gly Phe Arg Asn Trp Gln Lys Lys Glu Tyr Val Val Lys Pro Glu 620  
 1861 GAG ATG CTG CTG GAT CGT GCG CAG CTG ATG GGC TTA ACC GGC CCG GAA ATG ACC GTG CTG 1920  
 621 Glu Met Leu Leu Asp Arg Ala Gln Leu Met Gly Leu Thr Gly Pro Glu Met Thr Val Leu 640  
 1921 CTG GGC GGT ATG CGC GTA CTG GGC ACC AAC TAT GGT GGC ACC AAA CAC GGC GTA TTC ACC 1980  
 641 Leu Gly Gly Met Arg Val Leu Gly Thr Asn Tyr Gly Gly Thr Lys His Gly Val Phe Thr 660  
 1981 GAT TGT GAA GGC CAG TTG ACC AAC GAC TTT TTT GTG AAC CTG ACC GAT ATG GGG AAC AGC 2040  
 661 Asp Cys Glu Gly Gln Leu Thr Asn Asp Phe Phe Val Asn Leu Thr Asp Met Gly Asn Ser 680  
 2041 TGG AAG CCG GTA GGT AGC AAC GCC TAC GAA ATC CGC GAC CGC AAG ACC GGT GCC GTG AAG 2100  
 681 Trp Lys Pro Val Gly Ser Asn Ala Tyr Glu Ile Arg Asp Arg Lys Thr Gly Ala Val Lys 700

**FIG. 1D**

2101 TGG ACC GCC TCG CGG GTG GAT CTG GTA TTT GGT TCC AAC TCG CTA CTG CGC TCT TAC GCA 2160  
 701 Trp Thr Ala Ser Arg Val Asp Leu Val Phe Gly Ser Asn Ser Leu Leu Arg Ser Tyr Ala 720  
 2161 GAA GTG TAC GCC CAG GAC GAT AAC GCC GAG AAG TTC GTC AGA GAC TTC GTC GCC GCC TGG 2220  
 721 Glu Val Tyr Ala Gln Asp Asp Asn Gly Glu Lys Phe Val Arg Asp Phe Val Ala Ala Trp 740  
 2221 ACC AAA GTG ATG AAC GCC GAC CGT TTC GAC GTC GCG TCG TAA 2262  
 741 Thr Lys Val Met Asn Ala Asp Arg Phe Asp Val Ala Ser End 754

**FIG. 2A**  
***Microscilla furvescens*** Catalase - 53CA1

(SEQ ID NO: 7)  
 (SEQ ID NO: 8)

|     |   |     |
|-----|---|-----|
| 1   | ATG GAA AAT CAC AAA CAC TCA GGA TCT TCT ACG TAT AAC ACA AAC ACT GGC GGA AAA TGC     | 60  |
| 1   | Met Glu Asn His Lys His Ser Gly Ser Thr Tyr Asn Thr Asn Thr Gly Gly Lys Cys         | 20  |
| 61  | CCT TTT ACC GGA GGT TCG CTT AAG CAA AGT GCA GGT GGC GGC ACC AAA AAC AGG GAT TGG     | 120 |
| 21  | Pro Phe Thr Gly Gly Ser Leu Lys Gln Ser Ala Gly Gly Gly Thr Lys Asn Arg Asp Trp     | 40  |
| 121 | TGG CCC AAC ATG CTC AAC CTC GGC ATC TTA CGC CAA CAT TCA TCG CTA TCG GAC CCA AAC     | 180 |
| 41  | Trp Pro Asn Met Leu Asn Leu Gly Ile Leu Arg Gln His Ser Ser Leu Ser Asp Pro Asn     | 60  |
| 181 | GAC CCG GAT TTT GAC TAT GCC GAA GAG TTT AAG AAG CTA GAT CTG GCA GCG GTT AAA AAG     | 240 |
| 61  | Asp Pro Asp Phe Asp Tyr Ala Glu Glu Phe Lys Lys Leu Asp Leu Ala Ala Val Lys Lys     | 80  |
| 241 | GAC CTG GCA GCG CTA ATG ACA GAT TCA CAG GAC TGG TGG CCA GCA GAT TAC GGT CAT TAT     | 300 |
| 81  | Asp Leu Ala Ala Leu Met Thr Asp Ser Gln Asp Trp Trp Trp Pro Ala Asp Tyr Gly His Tyr | 100 |
| 301 | GGC CCC TTC TTT ATA CGC ATG GCG TGG CAG AGC GCC GGC ACC TAC CGT ATC GGT GAT GGC     | 360 |
| 101 | Gly Pro Phe Phe Ile Arg Met Ala Trp His Ser Ala Gly Thr Tyr Arg Ile Gly Asp Gly     | 120 |
| 361 | CGT GGT GGC GGT GGC TCC GGC TCA CAG CGC TTC GCG CCT CTC AAT AGC TGG CCA GAC AAT     | 420 |
| 121 | Arg Gly Gly Gly Ser Gly Ser Gln Arg Phe Ala Pro Leu Asn Ser Trp Pro Asp Asn         | 140 |
| 421 | GCC AAT CTG GAT AAA GCA CGC TTG CTT CTT TGG CCC ATC AAA CAA AAA TAC GGT CGA AAA     | 480 |
| 141 | Ala Asn Leu Asp Lys Ala Arg Leu Leu Trp Pro Ile Lys Gln Lys Tyr Gly Arg Lys         | 160 |
| 481 | ATC TCC TGG GCG GAT CTA ATG ATA CTC ACA GGA AAC GTA GCT CTG GAA ACT ATG GGC TTT     | 540 |
| 161 | Ile Ser Trp Ala Asp Leu Met Ile Leu Thr Gly Asn Val Ala Leu Glu Thr Met Gly Phe     | 180 |
| 541 | AAA ACT TTT GGT TTT GCA GGT GGC AGA GCA GAT GTA TGG GAG CCT GAA GAA GAT GTA TAC     | 600 |
| 181 | Lys Thr Phe Gly Phe Ala Gly Gly Arg Ala Asp Val Trp Glu Pro Glu Glu Asp Val Tyr     | 200 |
| 601 | TGG GGA GCA GAA ACC GAA TGG CTG GGA GAC AAG CGC TAT GAA GGT GAC CGA GAG CTC GAA     | 660 |
| 201 | Trp Gly Ala Glu Thr Glu Trp Leu Gly Asp Lys Arg Tyr Glu Gly Asp Arg Glu Leu Glu     | 220 |

FIG. 2B

661 AAT CCC CTG GGA GCC GTA CAA ATG GGA CTC ATC TAT GTA AAC CCC GAA GGA CCC AAC GGC 720  
 221 Asn Pro Leu Gly Ala Val Gln Met Gly Ile Tyr Val Asn Pro Glu Gly Pro Asn Gly 240  
 721 AAG CCA GAC CCT ATC GCT GCT GCG CGT GAT ATT CGT GAG ACT TTT GGC CGA ATG GCA ATG 780  
 241 Lys Pro Asp Pro Ile Ala Ala Arg Asp Ile Arg Glu Thr Phe Gly Arg Met Ala Met 260  
 781 AAT GAC GAA ACC GTG GCT CTC ATA GCG GGT GGA CAC ACC TTC GGA AAA ACC CAT GTT 840  
 261 Asn Asp Glu Glu Thr Val Ala Leu Ile Ala Gly Gly His Thr Phe Gly Lys Thr His Gly 280  
 841 GCT GCC GAT GCG GAG AAA TAT GTG GGC CGA GAG CCT GCC GCC GCA GGT ATT GAA GAA ATG 900  
 281 Ala Ala Asp Als Glu Lys Tyr Val Gly Arg Glu Pro Ala Ala Ala Gly Ile Glu Glu Met 300  
 901 AGC CTG GGG TGG AAA AAC ACC TAC GGC ACC GGA CAC GGT GCG GAT ACC ATC ACC AGT GGA 960  
 301 Ser Leu Gly Trp Lys Asn Thr Tyr Gly Thr Gly His Gly Ala Asp Thr Ile Thr Ser Gly 320  
 961 CTA GAA GGC GCC TGG ACC AAG ACC CCT ACT CAA TGG AGC AAT AAC TTT TTT GAA AAC CTC 1020  
 321 Leu Glu Gly Ala Trp Thr Lys Thr Pro Thr Gln Trp Ser Asn Asn Phe Phe Glu Asn Leu 340  
 1021 TTT GGT TAC GAG TGG GAG CTT ACC AAA AGT CCA GCT GGA GCT TAT CAG TGG AAA CCA AAA 1080  
 341 Phe Gly Tyr Glu Trp Glu Leu Thr Lys Ser Pro Ala Gly Ala Tyr Gln Trp Lys Pro Lys 360  
 1081 GAC GGT GCC GGG GCT GGC ACC ATA CCG GAT GCA CAT GAT CCC AGC AAG TCG CAC GCT CCA 1140  
 361 Asp Gly Ala Gly Ala Gly Thr Ile Pro Asp Ala His Asp Pro Ser Lys Ser His Ala Pro 380  
 1141 TTT ATG CTC ACT ACG GAC CTG GCG CTG GCG ATG GAC CCT GAT TAC GAA AAA ATT TCT CGA 1200  
 381 Phe Met Leu Thr Thr Asp Leu Ala Leu Arg Met Asp Pro Asp Tyr Glu Lys Ile Ser Arg 400  
 1201 CCG TAC TAT GAA AAC CCT GAT GAG TTT GCA GAT GCT TTC GCG AAA GCA TGG TAC AAA CTG 1260  
 401 Arg Tyr Tyr Glu Asn Pro Asp Glu Phe Ala Asp Ala Phe Ala Lys Ala Trp Tyr Lys Leu 420  
 1261 ACA CAC AGA GAT ATG GGA CCA AAG GTG CGC TAC CTG GGA CCA GAA GTG CCT CAG GAA GAC 1320  
 421 Thr His Arg Asp Met Gly Pro Lys Val Arg Tyr Leu Gly Pro Glu Val Pro Gln Glu Asp 440  
 1321 CTC ATC TGG CAA GAC CCT ATA CCA GAT GTA AGC CAT CCT CTT GTA GAC GAA AAC GAT ATT 1380  
 441 Leu Ile Trp Gln Asp Pro Ile Pro Asp Val Ser His Pro Leu Val Asp Glu Asn Asp Ile 460

FIG. 2C

1381 GAA GGC CTA AAA GCC AAA ATC CTG GAA TCG GGA CTG ACG GTA AGC GAG CTG GTA AGC ACG 1440  
 461 Glu Gly Leu Lys Ala Lys Ile Leu Glu Ser Gly Leu Thr Val Ser Glu Leu Val Ser Thr 480  
 1441 GCA TGG GCT TCT GCA TCT ACT TTT AGA AAC TCT GAC AAG CGC GGC GGT GCC AAC GGT GCA 1500  
 481 Ala Trp Ala Ser Ala Ser Thr Phe Arg Asn Ser Asp Lys Arg Gly Gly Ala Asn Gly Ala 500  
 1501 CGT ATA CGA CTG GCC CCA CAA AAA GAC TGG GAA GTA AAC AAC CCT CAG CAA CTT GCC AGG 1560  
 501 Arg Ile Arg Leu Ala Pro Gln Lys Asp Trp Glu Val Asn Asn Pro Gln Gln Leu Ala Arg 520  
 1561 GTA CTC AAA ACA CTA GAA GGT ATC CAG GAG GAC TTT AAC CAG GCG CAA TCA GAT AAC AAA 1620  
 521 Val Leu Lys Thr Leu Glu Gly Ile Gln Glu Asp Phe Asn Gln Ala Gln Ser Asp Asn Lys 540  
 1621 GCA GTA TCG TTG GCC GAC CTG ATT GTG CTG GCC GGC TGT GCG GGT GTA GAA AAA GCT GCA 1680  
 541 Ala Val Ser Leu Ala Asp Leu Ile Val Leu Ala Gly Cys Ala Gly Val Glu Lys Ala Ala 560  
 1681 AAA GAT GCT GGC CAT GAG GTG CAG GTG CCT TTC AAC CCG GGA CGA GCG GAT GCC ACC GCT 1740  
 561 Lys Asp Ala Gly His Glu Val Gln Val Pro Phe Asn Pro Gly Arg Ala Asp Ala Thr Ala 580  
 1741 GAG CAA ACC GAT GTG GAA GCT TTC GAA GCA CTA GAG CCA GCG GCT GAC GGC TTT AGA AAC 1800  
 581 Glu Gln Thr Asp Val Glu Ala Phe Glu Ala Leu Glu Pro Ala Ala Asp Gly Phe Arg Asn 600  
 1801 TAC ATT AAA CCG GAG CAT AAA GTA TCC GCT GAG GAA ATG CTC GTA GAC CGG GCG CAG CTT 1860  
 601 Tyr Ile Lys Pro Glu His Lys Val Ser Ala Glu Glu Met Leu Val Asp Arg Ala Gln Leu 620  
 1861 CTG TCG CTT TCG GCA CCA GAA ATG ACT GCT TTG GTA GGC GGT ATG CGT GTA CTG GGC ACC 1920  
 621 Leu Ser Leu Ser Ala Pro Glu Met Thr Ala Leu Val Gly Gly Met Arg Val Leu Gly Thr 640  
 1921 AAC TAC GAC GGT TCG CAG CAT GGA GTG TTT ACA AAT AAG CCG GGT CAG CTA TCC AAT GAC 1980  
 641 Asn Tyr Asp Gly Ser Gln His Gly Val Phe Thr Asn Lys Pro Gly Gln Leu Ser Asn Asp 660  
 1981 TTC TTT GTA AAC CTG CTA GAC CTC AAC ACT AAA TGG CGA GCC AGC GAT GAA TCA GAC AAA 2040  
 661 Phe Phe Val Asn Leu Leu Asp Leu Asn Thr Lys Trp Arg Ala Ser Asp Glu Ser Asp Lys 680  
 2041 GTT TTT GAA GGC AGA GAC TTC AAA ACT GGC GAA GTA AAG TGG AGT GGC ACC CCG GTA GAC 2100  
 681 Val Phe Glu Gly Arg Asp Phe Lys Thr Gly Glu Val Lys Trp Ser Gly Thr Arg Val Asp 700

FIG. 2D

2101 CTG ATC TTC GGA TCC AAT TCC GAG CTA AGA GCC CTC GCA GAA GTG TAC GGC TGT GCA GAT 2160  
 701 Leu Ile Phe Gly Ser Asn Ser Glu Leu Arg Ala Leu Ala Glu Val Tyr Gly Cys Ala Asp 720

2161 TCT GAA GAA AAG TTT GTT AAA GAT TTT GTG AAG GCC TGG GCC AAA GTA ATG GAC CTG GAC 2220  
 721 Ser Glu Glu Lys Phe Val Lys Asp Phe Val Lys Ala Trp Ala Lys Val Met Asp Leu Asp 740

2221 CGG TTT GAT CTG AAA TAA 2238  
 741 Arg Phe Asp Leu Lys End 746